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Penalty shooting and gaze behavior: Unwanted effects of the wish not to miss

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The intention to avoid a thought or action may ironically increase the tendency to engage in this thought or action. We show that in penalty shooting in soccer unwanted effects are mediated by changes in gaze behavior. Generally in far aiming, people look at where they aim, and they aim at where they look. With an indoor soccer-penalty task we first confirm this relationship. Next, we show that negatively formulated instructions not to shoot within reach of the keeper or outside the goal often direct the player's gaze to the area to-be-avoided, resulting in more unsuccessful shots. When visual attention is drawn to the to-be-avoided area there is probably not sufficient time to redirect attention to the proper location necessary for accurate aiming. These findings indicate that unwanted effects following the persistent wish not to miss may increase the probability of missing a decisive penalty.

KEY WORDS: Choking, Ironic processes, soccer

Introduction

It is a common phenomenon that the intention to avoid a thought or action may paradoxically increase the tendency to have this thought or engage in this action. (e.g., Bargh, Chen, & Burrows, 1996; Janelle, 1999; Wegner, 1994; Wegner, Ansfield, & Pilloff, 1998). A well-known example from the realm of thought suppression is that the instruction or intention 'not to think of a white bear' immediately leads to thoughts of precisely that which one wishes to avoid: a white bear (Wegner, Schneider, Carter & White,

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1987). Evidence for such unwanted ironic effects not only comes from the domain of thought control (Wegner & Erber, 1992), but has also been found in the perceptual motor domain. For instance, novice golf putters overshoot relatively more putts when instructed not to overshoot (Wegner et al., 1998; see also Beilock, Afremow, Rabe, & Carr, 2001).[1]

We suggest that unwanted effects may also manifest themselves in the penalty kick in soccer. Even though the penalty taker is generally assumed to have the advantage, a surprisingly large percentage of penalty kicks are missed, also among top players (about 25%, Kropp & Trapp, 1999). Clearly, missing a penalty may have far-reaching consequences, especially when it is part of a decisive shootout at a big tournament, such as, the European or World Championships. In contrast to Germany, for example, who won four out of five shootouts, the national squads of England and the Netherlands have a particularly poor reputation in penalty kicking (only one win out of six and five shootouts, respectively). Infamously, during the European Cup semifinal in 2000 against Italy, the Dutch took six penalty kicks and missed five of them. It is possible that unwanted effects following the persistent wish not to miss also played a role in missing these decisive penalty kicks.

One explanation for unwanted effects in perceptual-motor actions, which forms the core of Wegner's (1994) theory of ironic processes, is based on the notion that successful thought management relies on two cognitive processes: One controlled and the other automatic. The controlled process is initiated when an unwanted thought comes to mind. The role of the controlled process is to replace any unwanted thought with a more appropriate task-related thought. In contrast, the automatic search process scans the contents of consciousness for any trace of unwanted thoughts. When an unwanted thought is detected, the controlled system then "kicks in" and replaces this item. When attentional resources are taxed (e.g., high pressure situations), the controlled replacing process, which requires attention for successful initiation, can be compromised, resulting in the manifestation of unwanted thoughts and/or less-than-optimal performances.

Bargh et al. (1996) provide an alternative explanation, which is based on Williams James' principle of ideomotor action that the mere act of thinking about a behavior may increase the tendency to engage in that behavior. Bargh et al. propose that thinking about a behavioral response may have a priming

[1] It should be noted that Beilock et al. (2001) also found that individuals may overcompensate in performance in an attempt to avoid a particular outcome. For example, in a golf putting task instructions not to hit the ball past the target resulted in putts being left significantly short of the target.

effect on the likelihood of engaging in that response, even when the person is trying to avoid that behavior.

There are also suggestions in the literature that unwanted effects in perceptual-motor actions may be mediated by unwanted effects on attention (e.g., Dugdale & Eklund, 2002; Janelle, 1999). In aiming actions, such as the penalty kick, this would imply that negatively phrased intentions not to hit a specific target ironically draw attention to the target that the player is trying to avoid. This conjecture can be tested directly by measuring gaze behavior during action, as there appears to be a strong link between attention and gaze behavior (e.g., Deubel & Schneider, 1996; Henderson, 2003; Itti & Koch, 2001; Kowler, Anderson, Dosher, & Blaser, 1995). Negatively phrased intentions to avoid an undesired target may draw visual attention to that target, resulting in the detection of information that is less appropriate for the accurate execution of the action. If there is no opportunity to redirect attention (i.e., gaze) to more appropriate sources of information, task execution is predominantly based on less useful information, causing an inaccurate action. Specific circumstances preventing the redirection of attention may include high cognitive or physical load leading to a depletion of attentional resources, as is suggested in the theory of ironic processes (Wegner et al., 1998). But if in the perceptual-motor domain unwanted effects are mediated through visual attention then time constraints may also play a role, as even a brief excursion of attention to information that is less useful for accurate aiming may leave the player insufficient time to exploit the more appropriate information sources. This idea is supported by findings of, for instance, Beilock, Bertenthal, McCoy and Carr (2004) who demonstrated that limited performance time may indeed affect one's ability to regulate attention in the most effective manner.

So far, it has never been investigated directly whether unwanted changes in gaze, and hence, attentional focus (e.g., Henderson, 2003; Kowler, et al., 1995), occur and to what extent they can account for the unwanted effects in perceptual-motor actions. We therefore investigated gaze behavior and shooting accuracy of indoor penalty-kicks to a video projected goal and keeper (see Figure 1) that was executed under a moderate time constraint. In the task of accurately aiming a penalty kick in soccer less appropriate (e.g., the goalkeeper, or outside the goal) and more appropriate (i.e., the open goal space) gaze locations can be distinguished (see also Van der Kamp, 2006). It is now generally accepted that when aiming at a far target, a gaze fixation on the target location precedes the aiming action. Generally people look at where they aim, and vice versa, they aim at where they look (e.g., Land & Furneaux, 1997; Vickers, 1996; Williams, Singer, & Frehlich, 2002). In the first experiment we set out to confirm these observations for the task under investigation by

instructing participants to either attend to the goalkeeper or to the open goal space (called 'space' in the remainder of this paper), and comparing subsequent shooting performance. We hypothesized that performance would be better when shooters look at the space rather than the goalkeeper. More specifically, given the time constraint we expect that a first glance at the keeper would not leave enough time to redirect visual attention to the space long enough for accurate aiming. Establishing the relations among instruction, gaze behavior and performance provides an important prerequisite for sensible interpretation of the results of the second experiment in which we investigated whether the instruction to avoid the goalkeeper ironically draws visual attention to the goalkeeper resulting in poor kicking performance.

Experiment 1

Method

Participants and Design. Seven male amateur football players (mean age = 20.9 years, SD = 1.77) with an average of 11.6 years of football experience (SD = 2.64) participated in this experiment. All participants were actively engaged in football competition at the time of the study and practiced, on average, twice a week (totaling three hours). Informed consent was obtained, and rights of participants were protected in this and the second experiment. Participants took 30 penalties without run-up in each of three conditions aimed at directing attention to different areas of the display: (1) just shoot as well as possible: no-instruction condition; (2) shoot as well as possible and make sure to attend to the goalkeeper: keeper condition; (3) shoot as well as possible and make sure to hit the open (goal) space: space condition. As we wished to determine a baseline measure (both with respect to gaze behavior and performance) unaffected by additional instructions, Condition 1 was always the first condition. The other two conditions were counterbalanced.[2]

Apparatus and Procedure. Video clips of a stationary goalkeeper anticipating a penalty kick were shown on a large screen (2.29 by 2.27 m) with a projection size of 1.95 x 1.01 m (projected goal size = 1.65 x 0.55 m; see Figure 1). The clips were made with a digital video camera (Sony XJ 2000) from the perspective of a penalty taker. The projected goalkeeper stood either in the middle, or 0.5 or 1.0 m to the left or right from the middle of the goal (yielding five different positions) to force the shooters to vary their shooting direction (rather than to always shoot to the same side). This goal was reached as there was a clear relation between position of the goalkeeper and shooting direction, that is, when the keeper stood to the left most shots were taken to the right (252 of the 270), and vice versa (220 of the 229). This pattern of results was similar for the different instructions and participants.

[2] We checked for order effects as well as practice effects (by comparing the first 10 trials per condition with the last 10 trials). Although the analyses yielded some significant results, there were no systematic order or learning effects in this study (Experiments 1 and 2) that would favor our hypotheses.

Each of the five clips was repeated six times leading to 30 fully randomized trials. Before these experimental trials were executed the player was given time to get used to the set-up and the foam football (Ø = 19 cm, 131 gram; see Figure 1) that was used to take the penalties. A foam ball was used to keep the screen in-tact. At each presentation the player shot the foam football from a distance of 2.48 m at the video projection that was visible for one second. At that distance the visual angle subtended by the projected goal (height) was about 9°, hereby closely simulating the real image size of the goal and goalkeeper for a real penalty from 11 m. The player was instructed to make sure that the ball hit the screen within the 1 second that the projection lasted. Pilot testing had revealed that with 1 second participants just had about enough time to execute the task on time. With a projection lasting less than 1 second the number of trials for which the ball hit the screen too late increased considerably.

Gaze behavior was recorded using an Applied Science Laboratories (ASL) 501 eye-tracker system. The system works by collecting three pieces of information: displacement between the left pupil and corneal reflex (reflection of the light source from the surface of the cornea), position of eye in head, and position and orientation of head in space. The relative position of these features is used to compute visual point-of-gaze with respect to a pre-calibrated 9-point grid projected onto the scene plane. A simple eye calibration was performed to verify point-of-gaze before each participant was tested. After calibration gaze location was superimposed onto the scene in the form of a positional cursor to highlight point-of-gaze. The video image of the scene including the point-of-gaze cursor was then stored using a video recorder for further analysis. The accuracy of the system was ± 1 degree visual angle. The calibration of the system was checked before each trial and if necessary the system was recalibrated (this rarely happened).

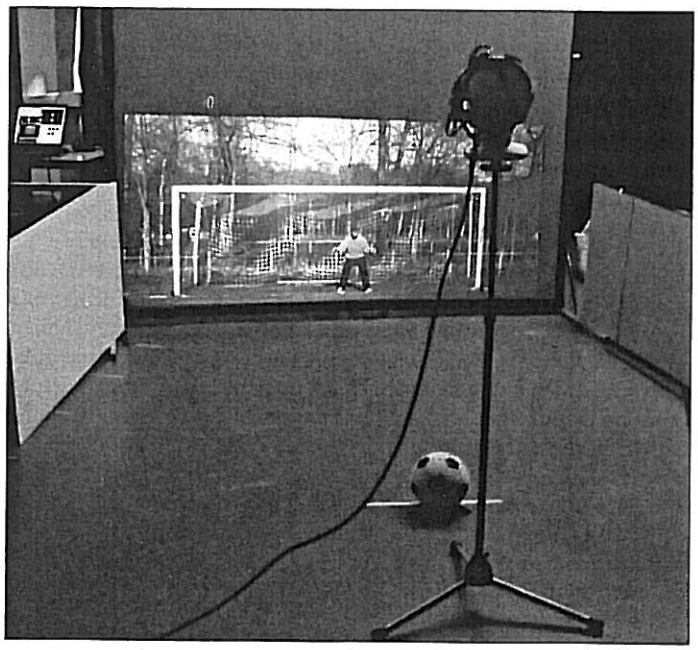

Fig. 1. Picture of the set-up.

Data reduction. The ASL recordings were analyzed frame-by-frame at 50 Hz using a JVC BR-DV3000U digital video recorder from the moment the film clip appeared to the moment the ball entered the view of the scene camera after ball contact. As we wished to find out whether the instructions would draw visual attention to specific locations (particularly the keeper or the space), hereby limiting attention to other locations, trials were primarily coded as to whether the initial gaze fixation (≥120 ms) was to the keeper or the space. As mentioned, given the time constraint we hypothesize that an initial glance at the keeper would not leave enough time to redirect visual attention to the space long enough for accurate aiming. By determining the location of the initial fixation we could investigate this hypothesis. Sometimes the first fixation was outside the goal and sometimes there were no fixations on either of these locations, which resulted in two additional categories. To be precise, we noted the initial gaze fixation location: 1) the keeper, initial fixation on the keeper followed by further fixations on the keeper or on the space,[3] 2) the space, initial fixation on the space followed by further fixations on the keeper or on the space,[4] 3) extrinsic, first fixation outside the goal, 4) unclassified, neither of the above: gaze shifted rapidly (no fixations) among multiple locations within the goal area including the keeper. This analysis yielded frequency counts of trials per individual per condition for which the primary gaze location was 1, 2, 3, or 4. An advantage of this frequency analysis is that individual patterns do not average out per condition. We were primarily interested in the occurrence of unwanted effects among individuals, rather than in the group as a whole. Per individual the frequencies per condition were analyzed using chi-square (χ^2) tests. As individual frequencies to locations 3 (extrinsic) and 4 (unclassified) were often not high enough to enter into the analyses, individual analyses were executed for locations 1 (keeper) and 2 (space) only. There was a high inter-observer agreement with regard to gaze behaviors for 90 trials of one participant when scored by a second independent observer, inter-observer agreement = 97%.

Shooting performance was obtained from ASL video-recordings by determining the location of the ball when it hit the projection screen. A penalty was considered 'successful' when it hit the goal within 1 s and out of reach of the keeper, operationalised as outside the real-size area of 2.96 x 2.48 m surrounding the keeper. A penalty was 'unsuccessful' when it hit the goal within 1 s inside the reachable area of 2.96 x 2.48 m surrounding the keeper, or

[3] It was possible to differentiate between initial fixations on the keeper followed by further fixations on the keeper ("keeper-keeper") and those followed by further fixations on the space ("keeper-space"). Analyses including this differentiation yielded similar patterns of results as the analyses without this differentiation. However, for a few of the individual analyses insufficiently high frequency counts remained after the differentiation, especially for the category "keeper-keeper" (in Experiment 2). Therefore, we only report the analyses without the differentiation. Nevertheless, it is important to know that in Experiment 1, 46% of the initial keeper fixations were followed by further fixations on the keeper (45%, 56% and 13% for the no, keeper, and, space instructions, respectively), while 54% were followed by further fixations on the space. In Experiment 2, 28% of the initial keeper fixations were followed by fixations on the keeper (32%, 28%, 17%, and 27% for the no, not-keeper, space, not-next instructions, respectively).

[4] Note that initial fixations on the space were never followed by fixations to other locations. Thus, after an initial fixation to the open space gaze remained within the open space area throughout the trial.

next to or over the goal. Shots that hit the screen too late were excluded from the statistical analyses on shooting performance (5.5% of all shots; they will be discussed in the Discussion). For primary gaze location it was tested using χ^2 tests whether they were associated with different success rates. Scoring of shooting performance yielded an inter-observer agreement of 94% when a second independent observer scored 90 trials of one participant.

Results

As shown in Table I the instructions led to different initial gaze locations for the group, $\chi^2(6) = 151.9$, $P < 0.0001$, also when extrinsic and unclassified gaze behavior (negligible frequencies) were excluded from the analyses, $\chi^2(2) = 140.5$, $P < 0.0001$. Most important, for all individuals, except participant 2 (see Table I), it was confirmed that different instructions led to different gaze locations, $\chi^2(2) > 10.0$, $Ps < 0.01$, implying that the overall results were not caused by only one or two extreme individuals.

TABLE I
Number of Penalties with the Gaze Directed Mainly at One of the Four Locations per Participant and Instruction Condition in Experiment 1.

		Gaze location			
Particip.	Instruction	Keeper	Space	Extrinsic	Unclass.
1	no-instr.	13	16	0	1
	keeper	25	5	0	0
	space*	12	11	0	0
2	no-instr.*	16	9	0	1
	keeper	16	14	0	0
	space	12	16	2	0
3	no-instr.	11	19	0	0
	keeper	21	9	0	0
	space	4	26	0	0
4	no-instr.	4	23	0	3
	keeper	23	5	0	2
	space	2	27	0	1
5	no-instr.	16	12	0	2
	keeper	28	2	0	0
	space	6	24	0	0
6	no-instr.*	6	23	0	0
	keeper	23	7	0	0
	space	2	28	0	0
7	no-instr.	12	18	0	0
	keeper	25	5	0	0
	space	2	28	0	0
Total	no-instr.	78	120	0	7
	keeper	161	47	0	2
	space	40	160	2	1

*One or more trials are missing because on those trials the gaze cursor was not visible on the video recordings. After such a trial the ASL system was immediately recalibrated.

To find out whether the differences that were found were in the expected direction (e.g., more initial looking at the keeper in the 'keeper' condition, and more to the space in the 'space' condition) separate analyses were done comparing the 'no-instruction' condition to the 'keeper' and the 'space' condition, respectively. It appeared that compared to the 'no-instruction' condition, in the 'keeper' condition more penalties had the keeper as primary gaze location and less penalties had the space as primary location, $\chi^2(1) = 60.5$, $P < 0.0001$. This was true for six of the seven individuals, $\chi^2(1) > 9.5$, $Ps < 0.01$. In the 'space' condition the pattern of results was reversed. That is, for more penalties the primary focus was on the space and for less penalties it was on the keeper, $\chi^2(1) = 17.9$, $P < 0.0001$ (Table I). This was confirmed for five of the seven individuals, three $\chi^2(1) > 4.4$, $Ps < 0.05$, two $\chi^2(1) > 2.4$, $Ps = 0.06$ (see Table I).

Furthermore, gaze location appeared to be closely related to the success of the shots (Table II). Overall penalties taken when looking at the space were significantly more often classified as 'successful', whereas penalties taken when initially looking at the goalkeeper were more often 'unsuccessful', $\chi^2(1) = 90.2$, $P < 0.0001$. Again, most important, this was also true for all individuals, $\chi^2(1) > 6.5$, $Ps < 0.05$.

These findings are only indicative of a strong relation between gaze and aiming location if most of the unsuccessful shots following a primary gaze at the keeper were within reach of the keeper rather than next to or over the goal. This appeared to be the case for 82% of the unsuccessful shots (i.e., 87%, 81%, and 76% in the no-instruction, keeper, and space conditions, respectively). When only these unsuccessful shots within reach of the keeper were included in the analysis of successful and unsuccessful shots, the pattern of results was the same: looking at the keeper led to more shots within reach of the keeper, while looking at the space led to more shots at the space, overall, $\chi^2(1) = 78.4$, $P < 0.0001$, and, again, for all individuals, $\chi^2(1) > 4.0$, $Ps < 0.05$.

TABLE II
Number of Successful and Unsuccessful Penalties as a Function of Gaze Location (Keeper or Space) per Participant in Experiment 1.

Particip.	Gaze loc.	Successful	Unsuccessful
1	keeper	20	26
	space	22	8
2	keeper	13	27
	space	30	9
3	keeper	5	27
	space	33	21
4	keeper	12	14
	space	42	13
5	keeper	18	26
	space	34	4
6	keeper	5	24
	space	40	18
7	keeper	17	18
	space	43	8
Total	keeper	90	162
	space	244	81

Experiment 2

Having established the close relation between gaze behavior and aiming accuracy in the indoor penalty task, we next set out to investigate how negatively formulated instructions affect gaze and aiming behavior in this task. Recall that the instructions in Experiment 1 were positively formulated. It is expected that negatively formulated instructions would induce unwanted effects in task execution, leading, for example, to more aiming and shooting within reach of the keeper when one is instructed not to shoot within reach of the keeper. Thus, if the conjecture that unwanted effects are mediated by gaze behavior is correct, then negatively phrased instructions to avoid shooting at the keeper or next to the goal would lead to more looking and shooting at these locations. Again, more specifically we hypothesized that given the time constraint initial fixations to locations other than the open space would leave insufficient time for a long enough fixation on the space to allow for accurate aiming. These hypotheses were tested in Experiment 2.

Method

Participants and Design. In the same setting as Experiment 1 ten male amateur football players (M age = 21.2 years, SD = 2.10) with 11.8 years of competition football experience (SD = 2.66) participated. All participants were actively engaged in football competition at the time of the study and practiced, on average, twice a week (totaling three hours). Participants were instructed (1) to just shoot as well as possible: no-instruction condition; (2) to shoot as well as possible and make sure that the goalkeeper could not reach the ball: not-keeper condition; (3) to shoot as well as possible and make sure that they hit the open space: space condition; and (4) to shoot as well as possible and make sure not to shoot next to the goal: not-next condition. Note that the meaning of instructions 2 and 3 is identical, as both urge participants to shoot at the space. As in Experiment 1, Condition 1 was always the first condition. The other conditions were counterbalanced (see also Footnote 1). None of the participants had participated in Experiment 1.

Apparatus and Procedure. The apparatus, procedure and analyses were the same as in Experiment 1. Again, there was a high inter-observer agreement (obtained over 90 trials of one participant) with regards to determining gaze behaviors (96%) and shooting performance (98%).

Results

Just as in Experiment 1, the instructions led to significant differences in gaze location on group level, $\chi^2(9) = 121.6$; $P < 0.0001$ (Table III). Given the small frequencies of trials with extrinsic and unclassified gaze behaviors it is important to note that this is also the case when only the gaze locations 'keeper' and 'space' were compared, $\chi^2(3) = 101.0$, $P < 0.0001$. Most important, different instructions led to significant differences in looking at the keeper or the space for all individuals, $\chi^2(3) > 7.5$, $Ps < 0.05$ (Table III).

To shed light on the direction of the differences that were found (which instructions led to which primary gaze locations), several pair wise comparisons were made between the

TABLE III

Number of Penalties with the Gaze Directed Mainly at One of The Four Locations per Participant and Instruction Condition In Experiment 2.

Particip.	Instruction	Gaze location			
		Keeper	Space	Extrinsic	Unclass.
1	no-instr.	9	15	1	5
	not-keeper*	18	8	2	1
	space	8	17	3	2
	not-next	9	16	1	4
2	no-instr.	3	22	2	3
	not-keeper	8	21	0	1
	space	2	27	1	0
	not-next	8	14	0	8
3	no-instr.	10	16	3	1
	not-keeper	14	16	0	0
	space	7	23	0	0
	not-next	17	12	1	0
4	no-instr.	8	19	2	1
	not-keeper	15	11	4	0
	space	4	24	2	0
	not-next	13	13	3	1
5	no-instr.	28	1	0	1
	not-keeper	11	14	4	1
	space*	3	19	1	6
	not-next	14	9	3	4
6	no-instr.	6	23	1	0
	not-keeper	12	16	1	1
	space	5	23	0	2
	not-next	13	14	3	0
7	no-instr.	10	16	2	2
	not-keeper	17	8	4	1
	space	1	24	0	5
	not-next	10	12	6	2
8	no-instr.	14	13	1	2
	not-keeper	14	14	1	1
	space	3	27	0	0
	not-next	10	15	2	3
9	no-instr.*	8	21	0	0
	not-keeper	12	13	2	3
	space	1	28	1	0
	not-next	12	11	7	0
10	no-instr.	10	20	0	0
	not-keeper	17	7	1	5
	space	1	25	4	0
	not-next	5	18	5	2
Total	no-instr.	106	166	12	15
	not-keeper	138	128	19	14
	space	35	237	12	15
	not-next	111	134	31	24

*One or more trials are missing because on those trials the gaze cursor was not visible on the video recordings. After such a trial the ASL system was immediately recalibrated.

conditions. First, it appeared that even though the negatively formulated keeper instruction urged participants to hit the space, it led to significantly less penalties during which the space was the primary gaze location and more penalties with the keeper as primary focus in comparison to the no-instruction condition, $\chi^2(1) = 9.0$, $P < 0.005$. This was true for six of the 10 individuals, $\chi^2(1) > 3.0$, $Ps < 0.05$, one $P = 0.07$. Second, as before, overall the space condition led to more penalties with a primary focus on the space and less penalties with a primary focus on the keeper than the no-instruction condition, $\chi^2(1) = 48.3$, $P < 0.0001$ (Table III), which was confirmed for five of the 10 individuals, $\chi^2(1) > 6.0$, $Ps < 0.05$. Most important, the direct comparison between the 'not-keeper' and the 'space' conditions (identical meaning, but differently phrased) revealed that the not-keeper instruction led to significantly less penalties during which the space was the primary gaze location and more penalties with the keeper as primary focus in comparison to the space instruction, $\chi^2(1) = 93.8$, $P < 0.001$ (Table III). This was also true for all 10 individuals, $\chi^2(1) > 3.0$, $Ps < 0.05$ (one $P = 0.058$). Regarding the second 'negative' instruction, the 'not-next' instruction, it should be noted that this instruction might have ironically drawn visual attention to areas outside the goal. Therefore, it is important to also include the 'extrinsic' gaze location in the analysis, even though the frequencies were not high (see Table III). With all gaze behaviors included in the analysis it appeared that the not-next instruction also led to significant changes in gaze behavior compared to the no-instruction condition, $\chi^2(3) = 14.0$, $P < 0.005$. As can be seen in Table III it seems that the not-next instruction led to relatively more penalties with initial fixations outside the goal or with unclassified gaze behavior than the no-instruction condition (individual frequencies were not sufficient to allow separate analyses).

When looking at the open space, shots were again more often categorized as 'successful', whereas looking at the goalkeeper, outside the goal, or showing unclassified gaze behavior were associated relatively more often with 'unsuccessful' shots, $\chi^2(3) = 88.2$; $P < 0.0001$ (Table IV, bottom four rows). Most important, for the majority of the individuals, 7 out of 10, this was confirmed for looking at the space and the keeper, $\chi^2(1) > 3.5$, $Ps < 0.05$ (see Table IV; individual frequencies of extrinsic and unclassified gaze behavior were too low to be included in the individual analyses). Additional analyses of the unsuccessful shots within reach of the keeper confirmed that looking at the goalkeeper was associated relatively more often with shots within reach of the keeper, while looking at the space led to more shots at the space. Again this was true for 7 of 10 individuals, $\chi^2(1) > 3.9$, $Ps < 0.05$ (overall $\chi^2(1) = 43.8$; $P < 0.0001$).

In addition to the above observations there were relevant findings concerning extrinsic and unclassified gaze behavior and shots that hit the screen too late (see Table IV, bottom rows). First, of the 74 shots that were characterized by gazes outside the goal (extrinsic) 52 (70.3%) were too late (Table IV). Even if the large numbers of shots with the primary focus on the keeper and the space are excluded this frequency of too late shots was significantly larger than the number of 'too lates' following unclassified gaze behavior, $\chi^2(2) = 20.5$, $Ps < 0.0001$. Second, of all the shots that were too late only 9% occurred while looking at the open space. 32.8%, 40.6% and 17.2% of the shots that were too late occurred while initially looking at the keeper, outside the goal, and when gaze behavior was unclassified, respectively (Table IV), $\chi^2(3) = 31.3$, $P < 0.0001$. Thus, there were significant differences in the number of 'too lates' depending on initial gaze location.

TABLE IV
Number of Successful and Unsuccessful Penalties as a Function of Gaze Location per Participant in Experiment 2. 'Too Lates' are Included for the Totals.

Particip.	Gaze loc.	Successful	Unsuccessful	Too late
1	keeper	21	21	
	space	43	13	
2	keeper	12	4	
	space	75	5	
3	keeper	15	30	
	space	40	25	
4	keeper	15	14	
	space	48	18	
5	keeper	29	25	
	space	29	14	
6	keeper	22	13	
	space	61	15	
7	keeper	19	13	
	space	33	27	
8	keeper	11	22	
	space	43	23	
9	keeper	10	20	
	space	55	17	
10	keeper	19	13	
	space	42	27	
Total	keeper	173	175	42
	space	469	184	12
	extrinsic	5	17	52
	unclass.	12	34	22

Discussion

In the present study we show that in taking penalties to a projected goal and keeper unwanted effects are mediated by unhelpful changes in gaze behavior. We first established a strong relation between the shooter's primary gaze direction and subsequent ball destination. Next, we showed that negative intentions (e.g., to avoid shooting at the keeper or next to the goal) ironically invited participants to look and aim at the to-be-avoided area more often. These results manifested themselves most clearly with respect to avoiding the keeper, but also the instruction not to shoot next to the goal ironically led to relatively more extrinsic and unclassified gaze behavior that apparently was associated with more misses than hits compared to the no-instruction condition (Table IV). These findings demonstrate that with negatively phrased instructions unwanted effects in penalty kicks may be triggered and that these effects are related to changes in gaze behavior.

Note that especially in the second experiment not all effects were evident for each and every individual. It is possible that for some individuals,

initial unwanted effects washed out after several repetitions. Bear in mind that, in contrast to Wegner et al. (1998) who investigated one golf putt per participant, we investigated no less than 30 repetitions per condition and still found unwanted effects for the majority of the participants. Of course, it is also likely that not everyone is equally susceptible to unwanted effects. It would be interesting to find out what underlies these differences (i.e., psychological traits, attentional strategies or something else). Furthermore, our findings should, of course, not be taken to imply that on the field penalties are also always characterized by similar patterns in (gaze) behavior. For one, on the field time-constraints are different from those employed here; a penalty taker usually has much more time than one second. Furthermore, in "real-life" penalty taking there is often interplay between the penalty taker and the goalkeeper during which both try to conceal their true movement intentions. In this context it is important to note that the findings so far suggest that the goal keeper does not use the kicker's gaze fixations as an anticipatory cue (Franks & Hanvey, 1997; Savelsbergh et al., 2002, 2005), so that there is no need for the kicker to try to fool the keeper with his gaze behavior. Finally, our experiment did not even begin to approach the pressurized situations with which penalty takers are confronted when taking a decisive penalty in a nerve-racking shootout (see Jordet et al., this issue). In short, the generalizability of the reported findings to on-field penalty taking should be viewed with caution.

Nevertheless, our results fit well with recent findings by Van der Kamp (2006) concerning the different strategies a penalty taker can adopt. In penalty shooting there are generally two ways to approach a shot: The penalty taker can choose the target location in advance (e.g., shoot to the lower right corner) and disregard any action of the goalkeeper (keeper-independent strategy), or the penalty taker can choose the target location depending on the goalkeeper's actions during the run-up (keeper-dependent strategy; Kuhn, 1988; Van der Kamp, 2006). By examining on-field penalty shots in an experimental setting, Van der Kamp (2006) recently revealed that the keeper-independent strategy is linked to more accurate shot placement since the only information needed to control the aiming action is the information about the far target. With the keeper-dependent strategy, information about the keeper is needed first to choose the shooting side; only then the shooter can start searching for information necessary for accurate aiming. Dividing attention over information that is less (keeper) and more (target location) useful for the control of the aiming actions appears to compromise the quality of shot placement (Van der Kamp, 2006). This is in agreement with the current findings showing that 'keeper-independent' shots (looking

at the space only) led to better performance than 'keeper-dependent' shots (also involving initial fixations at the keeper). Of course, it should be realized in this context that although each time the keeper was positioned in one of five different positions he remained stationary during a trial. As such, a 'keeper-dependent' strategy can only be narrowly defined with respect to the current experiments, not referring to a strategy depending on any movements of the keeper.

As for the underlying mechanisms of unwanted effects in the penalty kick, our findings do not unequivocally support either of the two explanations for unwanted effects presented in the introduction, ironic processes (Wegner, 1994) or priming (Bargh et al., 1996). Both the not-keeper and the not-next condition involved a negative instruction concerning the to-be-avoided area, which may have elicited ironic processes as suggested in Wegner's (1994) theory. However, in both cases, the to-be-avoided area was also primed (Bargh et al., 1996) as 'goalkeeper' and 'next to the goal' figured prominently in the respective instructions. The mere fact of being (more) occupied with either the goalkeeper or the area next to the goal through the instructions may have directed gaze as well as aiming behavior towards these areas. To be able to tease apart these possible mechanisms in future penalty experiments it seems appropriate to use positive and negative instructions that prime the same areas (as was done for golf putting by Wegner et al., 1998: aim at the hole vs do not aim past the hole; in both cases the hole is primed).

Whether the unwanted effects were the result of priming, inaccessible ironic processes, or other psychological processes, we now at least have an explanation at the behavioral level. Recall that participants executed the task with a specific time constraint: the ball had to hit the projection screen before the projection of the scene ended (within 1 second). This probably left insufficient time to redirect visual attention to the relevant location (space) after it was (ironically) diverted to an irrelevant location (keeper or next to the goal). This is supported by the finding that not just initial fixations to the keeper followed by further fixations to the keeper ("keeper-keeper"), but also initial fixations to the keeper followed by further fixations to the space ("keeper-space") led to less successful shots than fixations to the space only (see Footnote 3). Note that in Experiment 2, of the trials with initial fixations to the keeper 72% were accompanied by further fixations at the space (Footnote 3). Furthermore, although not discussed so far, it is striking that of the 33 shots that were too late in Experiment 1, 27 occurred when the initial gaze location was the keeper. Moreover, in Experiment 2 almost all shots (91%) that were too late occurred after looking at the keeper, next to

the goal, or after having unclassified gaze behavior (Table IV). Together these findings demonstrate that not immediately looking at the space (the target area) left insufficient time for accurate aiming and shooting.

Our results also seem to confirm that unwanted effects do not necessarily have to occur under increased mental load, but rather depend upon the specific circumstances (e.g., time constraints) under which the task at hand is executed (Jordet et al., this issue; Beilock et al., 2001; Wegner et al., 1998). Most important, the current study shows that unwanted effects in the perceptual-motor domain, particularly the penalty kick, are mediated by undesired changes in gaze behavior, and hence, attention. The intention to avoid a target may lead to (more) looking and aiming at precisely that which one wishes to avoid. The nerve-racking penalty shootout in football is often surrounded by negative thoughts or (self-)instructions directed at avoiding specific patterns of behavior (don't miss). It is important to learn to replace these negative thoughts about undesired targets by positive ones that direct attention to the desired target (e.g., hit the top corner of the goal) (Beilock et al., 2001). Trying to suppress negative thoughts is not a good strategy as it is as prone to the ironic effects as the negative thoughts themselves (Beilock et al., 2001; Janelle, 1999; Wegner & Erber, 1992). In sum, if soccer players are unable to approach a decisive penalty kick in a positive way with positive intentions, the persistent wish not to miss may ironically increase the probability that shooters do precisely what they intend to avoid, miss.

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